



COMBUSTION, MEASUREMENTS AND KINETICS

CLEAN ENERGY TECHNOLOGIES

TEST BED FOR NEW COMBUSTION TECHNOLOGIES

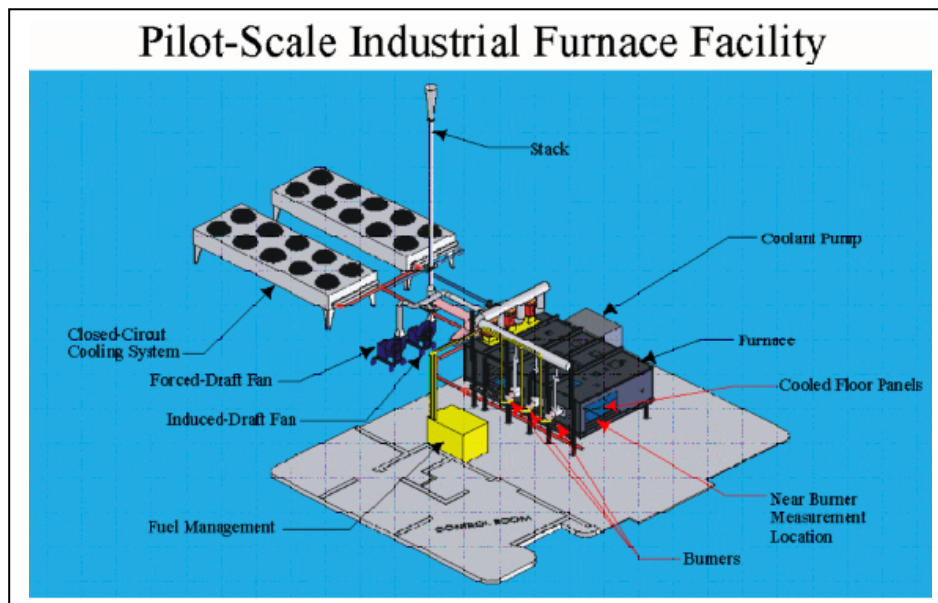
A critical role for industrial furnace operators in Canada is to seek out new ways of optimizing combustion performance of their furnace systems. However, making changes to operating furnaces often disrupts a company's production cycle. As a result, production schedules and quality usually take precedence when questions arise concerning the amount or cost of improvement. Natural Resources Canada's CANMET Energy Technology Center-Ottawa (CETC-Ottawa) provides a solution in the form of a Pilot-Scale Industrial Furnace (PSIF) that can be used for the development and implementation of advanced industrial burners and controls.

The PSIF minimizes the impact making changes has on production by giving operators the opportunity to turn to physical modeling, where a smaller-scale version of the process is studied. In this way, reliable measurements can be made of the furnace performance, and the modifications can be refined without interrupting the production. As well, operators can more accurately

estimate the impact of improvements and the costs involved.

This three-dimensional physical model can emulate the different configurations found in many industrial combustion processes. This furnace (Figure 1) is 4.5 m x 3.0 m x 1.0 m (inside dimensions) and because of the unique design, it can be modified to simulate any industrial furnace geometry. The existing furnace configuration has three sided wall burners and nine roof burners; however, any burner arrangement can be used in the PSIF, such as those that are found in conventional, recuperative and regenerative industrial processes.

With a firing rate of 1.2 MW, the temperature, heat transfer and chemical environment found in most industrial processes can be emulated as well. In conjunction with this furnace, the unique measurement and modeling capabilities available at CETC-Ottawa give Canadian industries a definite advantage in the development and evaluation of technologies for the improvement of the operation, control



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and performance of industrial furnaces. The facility is shown schematically in Figure 1. The furnace itself can be modified to include more burners, different burner configurations and other heat extraction systems to simulate industrial furnace and heater geometries.

Figures 2 to 4 show typical configurations for testing of various combustion technologies in the PSIF. In each of these testing scenarios the full range of measurement and burner control techniques can be studied with the intent of comparing or evaluating the furnace performance.

CETC-Ottawa Pilot-Scale Industrial Furnace and Measurements

Facilities:

New:

Pilot-scale industrial furnace

- Firing rate = 1.2 Mw, 3 or more burners
- Near burner measurement techniques (see below)
- Simulates various industrial combustion processes
- Can be used to compare and instruct on burner/process management strategies

Measurement Techniques:

Conventional techniques

- Intrusive probe for mapping gas and particle distribution, and velocity in flames
- Suction pyrometer for gas temperature
- 2π radiometer for radiant heat flux
- Calorimeter for total heat flux (34 Cooled Plates on Floor of Furnace)
- Visible camera for flame geometry

Advanced techniques

- Narrow angle radiometer for flame emissivity
- Laser based techniques e.g. CARS, LDV, LSI
- Flame emission spectroscopy
- Infra-red photography
- Intrusive probe for in-flame kinetics
- Probe for flow mapping
- Measurement of trace species emissions (39 elements)

The PSIF is an asset that will give Canadian industry the ability to develop and gain experience with new energy-efficient combustion technologies before installing them on their full-scale furnaces.

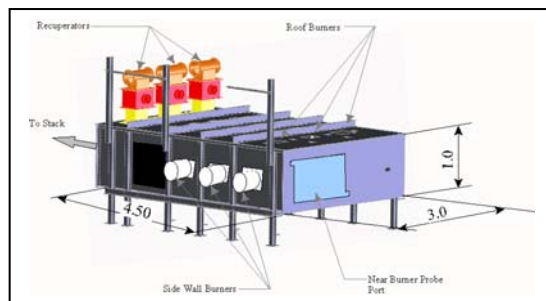


Figure 1: Schematic of the Pilot-Scale Industrial Furnace

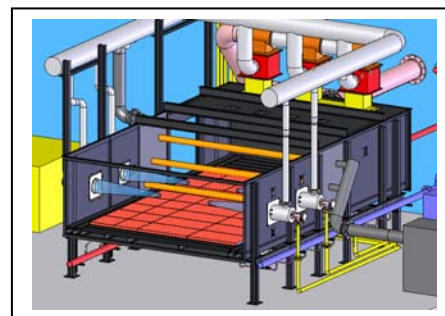


Figure 2: Furnace layout for testing of industrial heater (convective heat transfer) in PSIF.

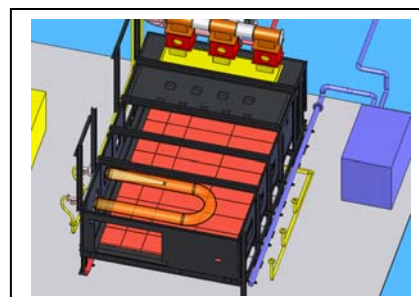


Figure 3: Furnace layout for testing of radiant tube performance in PSIF

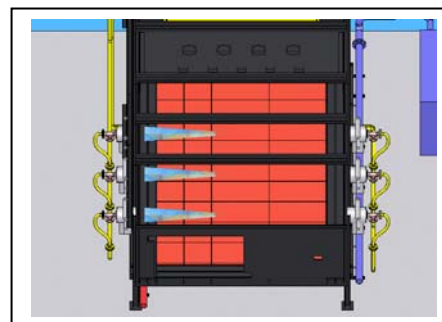




Figure 4: Furnace layout for testing of HTAC (low NOx regenerative) burner performance in PSIF.

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